SCIENCE

VOL. 89 FRIDAY, JANUARY 13, 1939 No. 2298

The American Association for the Advancement of Science:
Mathematicians and Poetry and Drama: PROFESSOR RAYMOND CLARE ARCHIBALD 19
Obituary:
Charles Edward Munroe: DR. C. A. BROWNE. *Recent Deaths and Memorials* 26
Scientific Events:
The Oceanographic Vessel Culver of the Bermuda Biological Station; Farm Research Laboratories of the U. S. Department of Agriculture; Annual Report of the Director of Field Museum, Chicago; The New York Meeting of the American Anthropological Association; Dr. Vannevar Bush, President of the Carnegie Institution of Washington 28
Scientific Notes and News 30
Discussion:
The Utilization of Microfilms in Scientific Research: DR. ATHERTON SEIDELL. *Improvement of Science Instruction:* PROFESSOR LLOYD W. TAYLOR. *The Benld Meteorite:* BEN H. WILSON. *What did the Blue Jay do with the Nut?:* PROFESSOR ARNOLD GESELL 32
Special Articles:
Mammary Carcinoma in the Rat with Metastasis Induced by Estrogen: DR. CHARLES F. GESCHICKTER. *Fumaric Acid Formation Associated with Sexuality in a Strain of Rhizopus Nigricans:* JACKSON W. FOSTER and PROFESSOR SELMAN A. WAKSMAN. *Gas Bubbles as Nuclei for "Oolites":* EDWIN B. ECKEL. *The Relation of Maximum Crushing Strength of Wood to the Degree of Swelling Induced by Various Chemicals:* DR. H. D. ERICKSON 35
Scientific Apparatus and Laboratory Methods:
A Simple Method for Filing Miniature Negatives and Microfilm Records in Strips: DR. LEE R. DICE. *Control of Mold in Food for Drosophilae:* PROFESSOR J. C. CROSS 39
Science News 6

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal
Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington, D. C.

MATHEMATICIANS, AND POETRY AND DRAMA[1]

By Professor RAYMOND CLARE ARCHIBALD

BROWN UNIVERSITY

IN general reading for a number of years I have been interested in accumulating information concerning, firstly, those who had not only achieved something noteworthy in mathematics but had also written verses or dramas; secondly, poems about mathematicians; and thirdly, the numerous incidental citations of mathematicians in poetry by poets of more or less distinction. Such general reading has not been confined to any one language, and translations of poetical or dramatic work of mathematicians were within the scope of my search. The large amount of material collected is in more than a score of languages, from the time of Pythagoras and his "Golden Verses"[2] down to the present. It is my purpose to give you some idea of the nature of this material. I am not aware that any one else has previously discussed this general theme.

The relations between poetry and mathematics have been considered by a number of writers;[3] but this is

[1] Address of the retiring vice-president and chairman of Section L (Historical and Philological Sciences), American Association for the Advancement of Science, delivered at a joint meeting of Sections A and L, of the American Mathematical Society and of the Mathematical Association of America; illustrated by 22 lantern slides. Richmond, Va., December 28, 1938.

[2] See, *e.g.*, "The Life of Pythagoras, with his Symbols and Golden Verses together with the Life of Hierocles, and his Commentaries upon the Verses. Collected out of the choicest manuscripts and translated into French, with annotations. By M. Dacier. Now done into English. The Golden Verses translated from the Greek," by N. Rowe. London, 1707. Greek text and Rowe's translation, pp. 149–164 + i–xi. "Pythagoras," a play by Martin Slaughter, was first acted in London in 1596.

[3] E. J. Wilczynski, "Poetry and Mathematics," *The University Chronicle*, 3: 191–204, 1900; read at the annual meeting of the Science Association May 2, 1900. I. Ionescu, "Matematica si poezia," *Gazeta Matematica*, 17: "Suppliment," pp. 1–3, May 15, 1912. D. E. Smith, (a) "Mathematics and Poetry," Florence, 1922, 8 pp.; (b) "Poetry of Mathematics," *Mathematics Teacher*, 19: 291–296, 1926; (c) "The Poetry of Mathematics and other Essays," New York, 1934, "The Poetry of Mathematics," pp. 1–13; contains practically all of (a). S.

not really a part of my topic, and I shall dismiss it after quoting a single paragraph from "My Friend the Mathematician," written more than fifty years ago by Percival Lowell, in a book on Korea.[4] This paragraph thus treats one of many phases of the subject:

> It has often been said that Poetry and Mathematics are own sisters. They differ in feature, but not in blood; and their common mother is Imagination. The saying will soon lose, if it has not already lost, the brilliant glitter of a seeming paradox, but only to be recognized with all the more distinctness as a truism. For art is to the senses what science is to thought, and both have their birth in the realms of fancy. To appreciate the one the senses must be acute, to understand the other the mind must be discerning; but to originate in either, this is truly dependent upon imagination in science as in art. The faculty has to do with thought pictures there, with sense creations here; but in both the creative idea comes from without the man himself. It comes suddenly upon him, as the flame, on relighting a candle that still is warm, appears to fall to the wick from the air above it. But the wick must be warm, the mind prepared or the spark never kindles.

Let us then consider some of those whose minds were prepared and on whom the flame descended. By way of illustration, I shall refer to at least a score of mathematicians who flourished during the past 2,200 years, in seven countries, and I shall try to suggest (to those of you who are not mathematicians) why most of them may be regarded as having achieved something of importance in mathematics, as well as what may be their connections with poetry or drama. Let us first of all turn to a group of Americans.

One of the leading research mathematicians of America at the present time, one who has been the recipient of more numerous international distinctions than any other, is George David Birkhoff (1884–), of Harvard University. After thirty years of meditation on the matter he published a book, in which he sought to bring the basic side of art, including music and poetry, within the purview of the simple mathematical formula defining "Aesthetic Measure," which is the title of his book.[5] There is a twenty-page chapter on "The musical quality of poetry," in which among other things the following topics are discussed: "The tripartite nature of verse" (that is significance, musical quality and meter), "The musical quality in poetry," "rhyme," "assonance," "alliteration," "the musical vowel sounds," "Poe's concept of verse," "poetry in other languages" and "the rôle of musical quality in poetry." He gives also an excellent "experimental poem" with his aesthetic measure indicated. It is as follows:

VISION

Wind and wind the wisps of fire
Bits of knowledge, heart's desire;
Soon within the central ball
Fiery vision will enthrall.

Wind too long, or strip the sphere
See the vision disappear.

Let us now consider another Harvard man, Thomas Hill[6] (1818–1891), president of the university for the six years 1862–68, immediately preceding President Eliot's régime. Among his books were the following mathematical works (1848–1887): "Elementary Treatise on Arithmetic," "Puzzles to Teach Geometry," "Geometry and Faith" (three editions), "An Elementary Treatise on Curvature." Also "A Fragmentary Essay on Curves" and (in collaboration with G. A. Wentworth) "A Practical Arithmetic." He invented the "occultator," an instrument for calculating eclipses and occultations, and a mechanical apparatus for determining latitude and longitude at sea. Now as to poetical contributions. In his senior year at Harvard he published a 16-page pamphlet, "Christmas, and Poems on Slavery."[7] Forty-five years later 120 of his poems, translations and imitations were brought together in a volume entitled "In the Woods, and Elsewhere."[8] His poetry was a perfectly natural flow of speech, and the best-liked pieces were those on subjects of nature written in free verse form. Perhaps the favorite was "Bloodroot," which appeared in the *Atlantic Monthly* for 1859 and was thought highly of by Oliver Wendell Holmes. The first eight lines may be quoted:

Beech trees, stretching their arms, rugged yet beautiful
Here shade meadow and brook; here the gay bobolink,
High poised over his mate, pours out his melody.
Here too, under the hill, blooms the wild violet;
Damp nooks hide, near the brook, bellworts that modestly,
Pale-faced, hanging their heads, droop there in silence, while
South winds, noiseless and soft, bring us the odor of
Birch twigs mingled with fresh buds of the hickory.

Another of Hill's excellent nature poems, "The

Buchanan, "Poetry and Mathematics," New York, 1929, "Poetry and Mathematics," pp. 3–24. G. Usai, "Matematica e poesia," Catania, 1932, 19 p.; inaugural address, Nov. 12, 1931, R. Istituto Superiore de Scienze Economiche e Commerciali di Catania.

[4] P. Lowell, "Chosön, the Land of the Morning Calm; a Sketch of Korea," Boston, 1886 [1885]; chapter 24, "My Friend the Mathematician," pp. 250–261.

[5] Cambridge, Mass., 1933, xvi + 226 pp. 23 plates. For further details of Birkhoff's life and work see R. C. Archibald, "A Semicentennial History of the American Mathematical Society, 1888–1938," New York, 1938, pp. 212–218.

[6] See *Scripta Mathematica*, 2: 78–79, 1933, and "Dict. Am. Biog.," v. 9, 1932.

[7] Cambridge, 1843; published by the author for the Massachusetts anti-slavery fair, Christmas, 1843.

[8] Boston, 1888, 237 pp. The first edition of this volume was a privately printed pamphlet (Portland, Me., 1887, 48 pp.), containing twenty poems.

Bobolink," was chosen by William Cullen Bryant for his "A Library of Poetry and Song."[9] Four of Hill's poems are in Griffith's collection, "The Poets of Maine,"[10] and his "Birthday Reflections" was published in London, as early as 1845, in a collection called "Flowers of Poetry."[11] These brief references to Hill's poetry must suffice.

During the first three quarters of the nineteenth century the most inspiring mathematician in the classroom of any American university was Benjamin Peirce (1809–1880), mathematician and astronomer, who taught at Harvard for half a century.[12] Not long ago President Emeritus Lowell recorded that he "still impresses me as having the most massive intellect with which I have ever come into close contact, and as being the most profoundly inspiring teacher that I ever had."[12] Peirce wrote a notable work on "Analytical Mechanics," and achieved remarkable pioneer results in linear associative algebra. At least three separate poems about him appeared in print.[13] Their general style can only be fully appreciated by those familiar with the life of Peirce and his modes of thought. The first, fourth and fifth stanzas of a ten-stanza poem published in the *Atlantic Monthly,*[14] by Oliver Wendell Holmes, Peirce's classmate at Harvard, were as follows:

For him the Architect of all
Unroofed our planet's starlit hall;
Through voids unknown to worlds unseen
His clearer vision rose serene.

How vast the workroom where he brought
The viewless implements of thought!
The wit how subtle, how profound,
That Nature's tangled web unwound;

That through the clouded matrix saw
The crystal planes of shaping law,
Through these the sovereign skill that planned,—
The Father's care, the Master's Hand!

In very recent days there has been another creative poet, a member of the present mathematical group in the National Academy of Sciences, who was a lecturer at Harvard in 1925–26. I refer to Eric Temple Bell[15] (1883–), a native of Aberdeen, Scotland, who came to America in his youth and was later greatly to enrich its cultural life. He has been a professor of mathematics at the California Institute of Technology for the past twelve years. Among his nineteen books are nine novels (written under the *nom de plume* of John Taine), and the remarkable "Men of Mathematics." But his first two books were volumes of verse "By J. T."[16] There is much to interest the mathematician in the manner of Bell's treatment of a wide range of themes, and of a variety of verse forms. The first volume contains sonnets on "Newton," "James Clerk Maxwell" and "William Thomson—Lord Kelvin," and a poem on "Johann Sebastian Bach." There are over seventy poems in the first volume and about a dozen in the second. In the latter, the first poem, "The Singer," fills over 120 pages. Bell's novel "Green Fire"[17] was dramatized into a three-act play by Glenn Hughes, and the Pasadena Community Playhouse Association gave several performances of it in 1931.

Turning next to another important scientific center in the state, the University of California at Berkeley, we find that only a few months ago death claimed one of her rarely gifted members of the mathematics department, who, for many years, had there achieved notably in the fields of mathematics, poetry and music. I refer to the beloved Derrick Norman Lehmer[18] (1867–1938), author of mathematical papers and of great mathematical tables, published by the Carnegie Institution and used by scholars throughout the world. For a decade before its recent demise he was the editor of the literary magazine, called the *University of California Chronicle.* He published scores of poems, some of them very extensive, in such periodicals as *Overland Monthly, Poetry, Silhouettes, Step Ladder, Lyric West, University of California Chronicle, Poetry Review* (London), *Poetry of To-day* (London) and *Atlantic Monthly;* and in "West Winds. An Anthology of Verse,"[19] in various volumes of "California Writers Club Poems"[20] and in other poetical anthologies.[21]

[9] New York, 1871, p. 345.

[10] G. B. Griffith, Portland, Me., 1888, pp. 211–214.

[11] Pp. 271–273. There is also Hill's "Prosing in Rhyme," in "The Centenary of Leicester Academy" . . ., Worcester, Mass., 1884, pp. 63–67.

[12] "Benjamin Peirce, 1809–1880, Biographical Sketch and Bibliography," by R. C. Archibald, and "Reminiscences," by C. W. Eliot, A. L. Lowell, W. E. Byerly and A. B. Chace, Oberlin, O., 1925. Reprinted with new material and portraits from *Am. Math. Mo.*, v. 32, 1925. See also "Dict. Am. Biog.," v. 14, 1934, pp. 393–397.

[13] By T. W. Parsons, T. Thwing and O. W. Holmes; see M. King, "Benjamin Peirce . . . A Memorial Collection," Cambridge, 1881.

[14] Vol. 46, 1880, pp. 823–824.

[15] See "Who's Who in America," v. 20, 1938; "American Men of Science," sixth ed., 1938; *Scripta Mathematica,* 2: 375–376, 1934.

[16] "Recreations," Boston, The Gorham Press, 1915, 151 pp.; "The Singer," *idem.*, 1916, 166 pp.

[17] "Green Fire, the Story of the Terrible Days in the Summer of 1890. Now told in full for the first Time," New York, Dutton, 1928.

[18] See "Who's Who in America," v. 20, New York, 1938; "American Men of Science," sixth ed., New York, 1938.

[19] By members of the California Writers Club, San Francisco, 1925, pp. 98–99, 103–104.

[20] San Francisco, 1930, pp. 21–24, group of children's poems ("That Strange Land," "Dandelion Faeries," "Rumpelstiltskin," "Old Daddy Red-Cap," "Giant Blunderbore"); 1932, "Spring Gossip"; 1933, "The New Thanatopsis" and "I?"

[21] A. H. Bartlett, comp., "Sea Anthology," London, 1924, "The Limpet"; E. Markham, comp., "The Book of Poetry," New York, 1926, "Riches"; E. Markham, comp., "Songs and Stories" (California Series), Los Angeles,

Lehmer was a virile master in the writing of ballads, where the tale is always forcefully told and the interest finely sustained. He collected ten of his best ballads in the recent volume, "Fightery Dick and Other Poems."[22] For twenty years he traveled among Indians of the West, and made hundreds of valuable phonograph records of their songs. To melodies and words, or vocables, thus obtained he has added suitable simple harmonies with flute obbligato and, in some cases, wrote English poetry in keeping with the music. He published a number of collections of such songs.[23] Furthermore, two Indian operas, "The Harvest" and "The Necklace of the Sun," for which he wrote both libretti and music, were performed with success in Oakland, San José and San Francisco, California, in 1933 and 1935.

In referring to Indians our thought naturally turns to Dartmouth College, which originated in Connecticut, as a charity school for Indians. At this college during 1911–1932 the head of the department of mathematics was a man of culture and of outstanding abilities as teacher, organizer, committee man and editor, John Wesley Young[24] (1879–1932). He also achieved noteworthy mathematical research publication. On his death the following poem,[25] which struck a responsive chord in the heart of every friend, was written by Alexander K. Laing, the prominent American poet and author:

VALE: CY YOUNG

A week ago: your hand, in my hand resting—
The shy, queer smile that never went away.
A week ago: your jest, to crown my jesting—
Sunlight at nightfall on a gloomy day.

Long I shall cherish that last careless meeting,
That picture, stamped unfading on the brain:
Symbol of you, who offered life a greeting
Of banter, for its surly gift of pain.

Great heart, grown quiet, merely to have seen you
Wear, as an honored garment, such great ruth,
Made us your debtors. Death cannot demean you
Who taught us manhood in our stumbling youth.

Arthur Sherburne Hardy[26] (1847–1930) was another professor of mathematics at Dartmouth College, namely, for the fifteen years 1878–93, and during that time he wrote not only volumes of mathematical texts such as: "Elements of Quaternions" (1881), "New Methods in Topographical Surveying" (1884), "Elements of Analytic Geometry" (1889) and "Elements of the Calculus" (1890), but also three novels, "But Yet a Woman" (1883), "Wind of Destiny" (1886), "Passe Rose" (1889) and a small volume, "Francesca of Rimini. A Poem."[27] This last volume was his first book, and it is written in Chaucerian rhyme royal. On leaving Dartmouth, Professor Hardy was for two years editor of the *Cosmopolitan Magazine*. Shortly thereafter followed eight years (1897–1905) as the United States minister to Persia, Greece, Roumania, Servia, Switzerland and Spain. Then, and later, six other novels and another volume of poetry flowed from his pen. This second volume of poetry, a product of the Merrymount Press, was given the title of its first part, "Songs of Two,"[28] and its second part, called "Verses," includes the poem "Duality," which had first appeared several years before.[29] Yet other poems of Hardy, written to a little child, are to be found in his "A May and November Correspondence,"[30] published shortly before he died.

Since Hardy was our ambassador to Persia and also to Spain, we may next appropriately visit these countries. Few there are who do not know of the Rubaiyat of the eleventh-century Persian poet, popularly known as Omar Khayyám,[31] and of Edward

---

1930, "The Stroller," "Riches"; H. Harrison, comp., "California Poets," New York (?), 1932, "The Feud," "Eviction"; "World's Fair Anthology," Exposition Press, New York, 1939, "Edgar Allan Poe"; "Golden Gate Anthology," Tudor House, New York, 1939, "Prophecy."

22 New York, 1936, x + 138 pp.

23 (a) "Seven Indian Songs from the Yosemite Valley," published under the auspices of The National Society of Colonial Dames resident in California, Berkeley, 1924, 19 + 4 pp., 4to, 8 songs with flute obbligato; (b) "Down the Stream and Other Indian Songs," Berkeley, 1927, 11 + 1 pp., 5 songs with flute obbligato; (c) "Two Indian Choruses" "Buffalo Song" and "Invocation to the Sun," Berkeley, 1927, 7 pp.; (d) "Indian Camp-Fire Songs. Easy four-part arrangements of Indian Songs for Junior and Senior High Schools," Berkeley, 1930, 15 pp., 8 songs; (e) "Indian Songs from the Northland," Berkeley, 1931, 13 pp., 5 songs; (f) "Fingers of the Sun and other Indian Songs from the Sierra Slopes," Berkeley, 1931, 13 pp., 6 songs; (g) "Indian Songs from the Mesas," Berkeley, 1932, 13 pp., 5 songs. He published also "Five Songs from the Tundras, an Eskimo Song Cycle," Berkeley, 1932, 9 pp.

24 See *Am. Math. Mo.*, 39: pp. 309–314, 1932; "American Men of Science," fourth ed., 1927; R. C. Archibald, "A Semicentennial History of the American Mathematical Society," 1938.

25 *The Dartmouth*, 93: 2, February 20, 1932.

26 "Dict. Am. Biog.," vol. 8, 1932. A. S. Hardy, "Things Remembered," Boston and New York, 1923.

27 Philadelphia, 1878, 46 pp.

28 New York, 1900, 36 pp.

29 "The First Book of the Authors Club; Liber Scriptorum," New York, 1893, p. 272.

30 Boston, Mass., 1928, 24 pp. and portrait and facsimile plates.

31 W. E. Story, "Omar Khayyám as a Mathematician" [Needham, Mass.], 1919, 17 pp. and portrait of Story (also in "Twenty Years of the Omar Khayyám Club of America," 1921, privately printed by the Rosemary Press; "Omar as a Mathematician," pp. 70–81; Poems, "Omar Khayyám," by N. H. Dole, pp. 28–30, by G. Roe, pp. 34–36). A. G. Potter, "A Bibliography of Printed Editions of the Quatrains of Omar Khayyám in Foreign Languages," privately printed for members of the Omar Khayyám Club of America, 1923. There is also a bibliography in E. Heron-Allen's edition and translation of the Rubaiyat, Boston, 1898, pp. 279–286. D. S. Kasir, "The Algebra of Omar Khayyám," New York, Columbia University, 1931, especially pp. 1–39. J. Hay, "In Praise of Omar," T. B. Mosher, Portland, Me., 1898; address be-

Fitzgerald's beautiful, though not wholly literal, translation of the Rubaiyat[32] into English in 1859. To this are largely due its popularity, the establishment of numerous Omar Khayyám clubs and a long series of special publications. It is not so generally known that Omar Khayyám was the originator of a notable calendar, and wrote an important work on algebra, as well as a commentary on difficulties in Euclid's "Elements," very much like early discussions of non-Euclidean geometry.[33]

Fitzgerald's work in connection with 101 quatrains was sufficient to impel various other people to rush into print with translations of other quatrains of more or less doubtful authenticity; thus Whinfield gave 500 quatrains.[34] Another, innocent of knowledge of Persian, conceived the idea of eliminating the more doubtful of this number and having a Persian scholar make a literal translation into English of 289 quatrains, so as to give, as he conceived it, a truer picture of the original text. Having this literal translation before him he put it into metrical form and had it published in a most beautiful volume adorned with twelve remarkable illustrations in colors by an eminent Persian artist.[35] The author of this metrical translation, David Eugene Smith[36] (1860–), is one of the best loved among American mathematicians, and great is the debt which the United States owes to him for inspiring so many of the teaching fraternity. The popularity of his text-books and historical writings may be inferred from the fact that during each of the three years 1927–29, more than a million copies of his books were sold by his publisher. These included Spanish editions of several of his works used in Cuba and South America.

Omar's quatrains have been translated into many languages, and in some of these languages many translations have been made, in part antedating the translation of Fitzgerald. Danish, French, German and Italian translations are well known; but there have also been Basque, Catalanese, Czech, Dutch, Esperanto, Gaelic, Hebrew, Hungarian, Japanese, Latin, Welsh, Welsh Romany and Yiddish. There are many musical settings for the quatrains, of which the beautiful ones of Liza Lehmann, finely recorded on gramophone records, are the most notable.

Many poems about Omar have been brought together in a little volume edited by E. M. Moore.[37] Among the authors of these are the following: T. B. Aldrich, Austin Dobson, Edmund Gosse, Andrew Lang, R. Le Gallienne, J. R. Lowell, J. H. McCarthy and Stephen Phillips.

And now to Spain! The mathematician of all time to attain the greatest financial reward for his poetic and dramatic efforts was the very gifted and versatile Spaniard, José Echegaray,[38] who was born in 1832 and died in 1916. He ruled the Spanish stage unchallenged for the twenty years 1874–1894, and was a Nobel prize winner in literature in 1904, when 72 years of age, "in appreciation," to use the words of the award, "of his comprehensive and intellectual authorship which, in an independent and original way, has brought to life again the great traditions of Spanish drama."[39] Of the 65 dramatic pieces which he wrote many were translated into foreign languages such as Dutch, English, French, German, Greek, Italian, Portuguese and Russian. English translations[39] of "The Madman Divine," "Madman or Saint" and "Always Ridiculous" were published in Boston, in *Poet Lore*. But these are said to be trivial in literary value beside two of later years, "The Great Galeoto" and "The Son of Don Juan."

Echegaray's writing of plays began about 1868, when he was appointed professor of mathematical physics at the University of Madrid, and became a member of the Cortes. For five years he was minister of public works and finance. He is the author of

fore the Omar Khayyám Club, London, Dec., 1897. G. Sarton, "Introduction to the History of Science," vol. 1, Washington, 1927, pp. 759–761; H. Lamb, "Omar Khayyám, A Life," Garden City, N. Y., 1934, viii + 316 pp. Romances: (a) N. H. Dole, "Omar, the Tentmaker; a Romance of Old Persia," Boston, 1899, viii + 365 pp.; (b) H. Macfall, "The Three Students," London, 1926, viii + 351 pp., attractively written. G. Sarton, "The Tomb of Omar Khayyám," *Isis*, 29: 15–19, 1938, with plate illustration of the magnificent tomb at Nishâpûr. See also J. Fleming, "A Pilgrim to Omar's Forgotten Tomb," *Travel*, 58: 9–14, April, 1932.

[32] The four Fitzgerald editions of the Rubaiyat (1859–79) were brought together in a single volume of the Golden Treasury Series, London, 1899. See also the beautiful edition of Thomas B. Mosher, Portland, Me., 1902.

[33] D. E. Smith, "Euclid, Omar Khayyám, and Saccheri," *Scripta Mathematica*, 3: 5–10, 1935.

[34] E. H. Whinfield, London, 1883.

[35] New York, 1933.

[36] *Scripta Mathematica*, 4: 182–184, 1936, and *Osiris*, 1: 9–84, 1936, with portrait. While traveling in Persia shortly after his Omar was published, Professor Smith was presented to the Shah, decorated with the Gold Star of the Order of Elim, of the first rank, and presented with an autographed portrait of the Shah.

[37] "To Omar. Spoil of the North Wind," Blue Sky Press, Chicago, 1900, 93 pp.

[38] J. Cejador y Frauca, "Historia de la Lengua y Literatura Castellana," Madrid, v. 9, pp. 111–128, 1918, with portrait; G. B. Shaw, "Dramatic Opinions and Essays," New York, 1907, v. 1, pp. 81–89; v. 2, pp. 186–194; N. A. Smith, "José Echegaray," *Poet Lore*, 20: 218–228, 1909; S. G. Morley, "José Echegaray," *Univ. California Chronicle*, 27: 368–379, 1925; F. W. Chandler, "Modern Continental Playwrights," New York, 1931, "Peninsular Tradition: Echegaray, Pérez Galdós Guimerá," pp. 465–486; *Scripta Mathematica*, 1: 265–266, 1933.

[39] A. R. Marble, "The Nobel Prize Winners in Literature," New York, 1925, pp. 239–246, 282–283 (bibliography). For further bibliography of Echegaray see A. Flores, "Spanish Literature in English Translation, a Bibliographical Syllabus," New York, 1926, pp. 46–48; various editions of ten plays in English translation are listed.

many mathematical and scientific works on such subjects as calculus of variations (1858), theory of determinants (1868), elementary theory of thermodynamics (1868), mathematical theory of light (1871), modern theories of physics (5 v., 1883–89), and popular science (2 v., 1905). At the time of his death in 1916 he was the president of the Spanish Mathematical Society.[40]

In listing Omar's mathematical work I referred to his commentary on one of the works of Euclid. The magnificently endowed University of Alexandria opened about 300 B.C., and Euclid was there a professor of mathematics. Not less than ten mathematical treatises are to be attributed to him as author, and of these approximately complete texts of five are available. But by far the most famous one was his monumental work on geometry, containing 465 propositions, called "The Elements." More than a thousand editions have appeared since the first one[41] printed in 1482, and for 1,800 years before that, manuscript copies dominated all teaching of geometry. The following old English verses, which Halliwell has printed in one of his books,[42] show, if his ms. source is reliable, that Euclid's work was used in England as far back as King Adelstone, early in the tenth century.

The clerk Euclide on this wyse hit fonde
Thys craft of geometry, yn Egypte londe
Yn Egypte he tawghte hyt ful wyde,
In dyvers londe on every syde.
Mony yerys afterwarde y understonde
Yer that the craft com ynto thys londe.
Thys craft com into England, as y yow say,
Yn tyme of good Kyng Adelstone's Day.

There are many incidental references to Euclid in poetry. For example, in the fifth book of Wordsworth's "Prelude" the following lines may be recalled in the dream, which, according to De Quincey, "reaches the very *ne plus ultra* of sublimity":

I looked and looked, self-questioned what this freight
Which the new-comer carried through the waste
Could mean, the Arab told me that the stone
(To give it in the language of the dream)
Was "Euclid's Elements."

During the past fifteen years two poems on Euclid have been published in this country—the one by Vachel Lindsay[43] and the other by Edna St. Vincent Millay.[44] The latter's sonnet is as follows[44a]:

Euclid alone has looked on Beauty bare.
Let all who prate of Beauty hold their peace,
And lay them prone upon the earth and cease
To ponder on themselves, the while they stare
At nothing, intrically drawn nowhere
In shapes of shifting lineage; let geese
Gabble and hiss, but heroes seek release
From dusty bondage into luminous air.
O blinding hour, O holy, terrible day,
When first the shaft into his vision shone
Of light anatomized! Euclid alone
Has looked on Beauty bare. Fortunate they
Who, though once only and then but far away,
Have heard her massive sandal set on stone.

And now for another Greek of slightly later day. Should mathematicians be asked, who were the five greatest mathematicians who ever lived, their responses would probably agree, and the list begin with the names of Archimedes[45] and Newton. Archimedes, who flourished about 225 B.C., made most extraordinary discoveries, some of which called for use of what is equivalent to the solution of problems by the integral calculus, first later developed in more detail by Newton. Two of these results are that the volume of a sphere is exactly equal to two thirds that of its circumscribed cylinder, and that the area of the sphere was exactly equal to that of the cylinder. Archimedes was so proud of proving these results, he requested that the figure of a sphere in a cylinder be engraved on his tomb; Cicero found it there, as he tells us in his "Tusculan Disputations."

In this mechanistic age one may well recall Wordsworth's lines on Archimedes in book 8 of "The Excursion":[46]

Call Archimedes from his buried tomb
Upon the plain of vanished Syracuse,
And feelingly the sage shall make report
How insecure, how baseless in itself
Is the philosophy, whose sway depends
On mere material instruments; how weak
Those arts, and high inventions, if unpropped
By virtue.—

Somewhat the same underlying thought is suggested

[40] J. A. Sánchez Pérez, *Revista Matemática Hispano-Americana*, ser. 2, 7: 49–58, 1932, with portrait frontispiece of Echegaray; see also *Revista de la Sociedad Matemática Española*, 5: 281–282, 1916, and 6: 1–6 (by P. Carrasco), 1917.

[41] P. Riccardi, "Saggio di una Bibliografia Euclidea," Bologna, 1887–93; C. Thomas-Stanford, "Early Editions of Euclid's Elements," London, Bibliographical Society, 1926.

[42] J. O. Halliwell, "Rara Mathematica," second ed., London, 1841, p. 56, reproduced from Ms. Bib. Reg. Mus. Brit. 17A.1.f2[b] – 3, which dates from the fifteenth century.

[43] V. Lindsay, (a) "Collected Poems," rev. and illustr. ed., New York, 1926, p. 231 in "Moon-Poems"; (b) "Golden Book," v. 13, 1931, p. 31.

[44] E. Millay, "The Harp-Weaver and Other Poems," New York, 1923, p. 74. See also "The Home Book of Modern Verse," ed. by R. E. Stevenson, New York, 1925, p. 822; and "The Riverside Book of Verse 1250–1925," ed. by R. M. Gay, Boston and New York, 1927, p. 610.

[44a] I am indebted to Miss Millay (Mrs. Boissevain) for kind permission to reprint this sonnet.

[45] T. L. Heath, (a) "Archimedes" (Pioneers of Progress) London, 1920; (b) "Manual of Greek Mathematics," Oxford, 1931. *Scripta Mathematica*, 2: 75–76, 363, 1933; 4: 82, 273–274, 1936.

[46] "The Complete Poetical Works of William Wordsworth," Cambridge ed., Boston, 1904, bk. 8, 11. 220–227.

by Schiller's poem, "Archimedes und der Schüler,"[47] which may be roughly translated as follows:[48]

To Archimedes once came a youth intent upon knowledge.
Said he "Initiate me into the science divine,
Which to our country has borne glorious fruits in abundance,
And which the walls of the town 'gainst the Sambuca protects";
"Callst thou the science divine? It is so," the wise man responded;
"But so it was, my son, ere the state by her service was blest.
Would'st thou have fruit of her only? Mortals with that can provide thee,
He who the *goddess* would woo, seek not the woman in her."

There are many other allusions to Archimedes and his work in poetry of different languages, but I shall not touch upon these except to draw attention to Stephen Vincent Benet's 120-line poem, "Archimedes' last foray,"[49] published about thirteen years ago with the motto, "And . . . having sought for a lever wherewith to move the world . . . he was slain . . . ."

The reference to Wordsworth leads next to consideration of one of his intimate friends. In Great Britain in the first half of the nineteenth century there were two great scholars of similar names. The older was Sir William Hamilton, baronet, one of the most eminent of Scottish metaphysicians, and the other Sir William Rowan Hamilton, knight (1805–1865), outstanding Irish mathematician.[50] The latter was a child prodigy, like John Stuart Mill. At three years of age he was a superior reader of English and considerably advanced in arithmetic; at four a good geographer; at five able to read and translate Latin, Greek and Hebrew, and liked to recite Dryden, Collins, Milton and Homer; at eight a reader of Italian and French and giving vent to his feelings in extemporized Latin; at ten a student of Arabic and Sanscrit. When twelve years old he met Zerah Colburn, the American calculating boy,[50a] and engaged with him in trials of arithmetical skill in which Hamilton came off with honor. His career at Trinity College, Dublin, was extraordinary in that he achieved the previously unheard-of distinction of winning the highest possible marks both in mathematical physics and in Greek. Before entering college he was accustomed to translate Homer into blank verse, comparing his result with translations of Pope and Cowper, and he had already produced a number of original poems. These poems and about 100 others have been preserved in Hamilton's monumental biography.[51] While still an undergraduate Hamilton was appointed professor of astronomy. Before assuming the duties of his chair he made a tour through England and Scotland and thus met the poet Wordsworth for the first time, in 1827. The two men took to each other at once, and they remained close friends up to the day of the poet's death 23 years later. Wordsworth greatly loved and admired the young mathematician, declaring that Coleridge and Hamilton were the two most wonderful men, taking all their endowments together, that he had ever met. Here is Hamilton's account of their first meeting:

"Wordsworth with whom I spent the evening—I might almost say the night—of yesterday, for he and I were taking a midnight walk together for a long, long time, without any companion except the stars and our own burning thoughts and words." He goes on to record how Wordsworth walked back with him to his lodging about a mile distant. Hamilton then offered to return with Wordsworth, and their conversation was so interesting that, arrived at his house, Wordsworth turned back once more, when Hamilton again accompanied him home. From then on he sent Wordsworth the verses which he wrote in great quantity and with great facility. In 1831 Wordsworth wrote[52]: "You send me showers of verses which I receive with much pleasure, as do we all: yet have we fears that this employment may seduce you from the path of science which you seem destined to tread with so much honor to yourself and profit to others. Again and again I must repeat that the composition of verse is infinitely more of an art than men are prepared to believe, and absolute success in it depends upon innumerable *minutiae* which it grieves me you should stoop to acquire a knowledge of. . . . Again I do submit to your consideration, whether the poetical parts of your nature would not find a field more favorable to their exercise in the regions of prose; not because those regions are humbler, but because they may be gracefully and profitably trod, with footsteps less careful and in measures less elaborate." While Hamilton continued to indulge in poetical effusions with no little copiousness, Wordsworth's counsels were sufficient to decide him to dedicate his life to

[47] For example, Schiller, "Sämmtliche Schriften," hist.-krit, Ausg. v. K. Goedeke, 11: 92, 1871. Compare "Archimedes und der Jüngling," a parody by C. G. J. Jacobi, Crelle's *Jour. f. Math.*, 101: 338, 1887, or Kronecker, "Werke," Leipzig, v. 3, 1899, p. 252.

[48] R. E. Moritz, "Memorabilia Mathematica," New York, 1914, p. 138.

[49] See, for example, W. S. Braithwaite, ed., "Anthology of Magazine Verse for 1926," Boston, 1926, pp. 36–40; *Saturday Rev. Lit.*, 2: 871, June 19, 1926.

[50] A. Macfarlane, "Lectures on Ten British Mathematicians of the Nineteenth Century," New York, 1916, pp. 34–49. E. T. Bell, "Men of Mathematics," New York, 1937, pp. 340–361.

[50a] "A Memoir of Zerah Colburn written by Himself," Springfield, Mass., 1833; F. D. Mitchell, "Mathematical Prodigies," *Amer. Jour. Psychology*, 18, 1907.

[51] R. P. Graves, "Life of Sir William Rowan Hamilton, knt.," 3 v., Dublin, 1882–89.

[52] Graves, "Life," v. 1, pp. 491–492.

scientific research. In this direction three achievements may be mentioned: his notable discoveries in geometrical optics; "Hamiltonian equations," which are fundamental in discussions of dynamical problems; and his great works on quaternions, a subject of which he was the creator.

I wonder if it may not have been mainly due to association with Hamilton that Wordsworth's poems contain at least a dozen references, more, I believe, than made by any other poet, to mathematics and mathematicians. Most of these references are in "The Prelude," but there are others in "The Excursion" and in "Epitaphs translated from Chiabrera."

(To be concluded)

OBITUARY

CHARLES EDWARD MUNROE

THE death of Professor Charles Edward Munroe in his ninetieth year at his home in Forest Glen, Maryland, on the afternoon of December 7, 1938, marked the passing of a distinguished and most beloved American man of science. He was born in Cambridge, Massachusetts, on May 24, 1849, and his long career as student, teacher, consulting expert and investigator of chemistry spanned the entire period of modern industrial development.

Munroe's love of chemistry began early, and from first to last it was joyful, compelling and infectious. As a young boy he equipped a small chemical laboratory in an attic room, over the entrance of which, in the merry spirit that always stayed with him, he inscribed the words, "All hope abandon ye who enter here." Desirous of increasing his stock of chemicals, he went one day to the neighboring drug store of Dr. Abner Ham to buy an ounce of potassium cyanide. The venerable doctor peered down at the lad through his glasses and asked with surprise what he wished to do with so poisonous a substance. "To make experiments," replied the boy. Dr. Ham then questioned him and, finding that he had picked up an amount of chemical knowledge unusual for one so young, decided that what he needed most was not potassium cyanide but direction. He offered him therefore a position as helper and errand boy, together with the opportunity of making such chemical experiments as discretion and the resources of his store permitted. The proposal was eagerly accepted.

The zeal for chemistry, thus early aroused, accompanied Munroe into the Cambridge High School and then through the Lawrence Scientific School of Harvard, from which he graduated in the class of 1871 with the mark of *summa cum laude*. For the next three years he taught chemistry at Harvard in the courses of Professors O. Wolcott Gibbs and Josiah P. Cooke, of both of whom Munroe always spoke with admiring affection. Although there was a certain professional coolness between Gibbs and Cooke, Munroe was successful in maintaining cordial relations with both. In fact a cardinal trait of his character was a conciliatory spirit which made it impossible for him to become a partisan in the quarrels of his friends.

Among Munroe's chemistry pupils at Harvard was Harvey W. Wiley, of the class of '73, and between those two arose a deep and lasting friendship. Wiley, who was Munroe's senior by five years, was then pursuing a year of postgraduate study and being a B.A. of Hanover College had no intention of taking another degree. Munroe, however, persuaded him to try for a B.S. at Harvard, but the regulations required that he must first pass the examinations for each of the four college years. Wiley, after being duly coached by Munroe, had no difficulty in fulfilling this requirement, and he thereby attained the unique distinction of being promoted from freshman to senior year in the brief space of seventeen days. Helping Wiley to run this gauntlet of tests was jokingly referred to by Munroe as his greatest pedagogical achievement.

Munroe left Harvard in 1874 to accept the professorship of chemistry at the United States Naval Academy, where he remained until 1886. He then transferred his residence to Newport, where he served as chemist of the United States Naval Torpedo Station and War College until 1892. It was during this period that he conducted his famous researches on explosives. His fearless experiments in this field led to the invention of the smokeless powder called "Indurite" (U.S. Patent 489684) and to the discovery of the remarkable Munroe effect by which the outlines of a fragile leaf or photograph can be impressed upon a plate of the hardest steel by means of a powerful explosive. In 1892 he moved to Washington, where he served as professor of chemistry and dean of the Graduate School of George Washington University until his retirement as professor emeritus in 1918. He continued, however, to serve as consulting expert and chief explosives chemist of the U. S. Bureau of Mines until 1934, when failing health obliged him to resign the position.

Coincident with these main activities, Munroe discharged various miscellaneous public services which are too numerous to mention in detail. He was a member of the U. S. Assay Commission for 1885, 1890 and 1893 and consulting expert of the engineering board for the defense of Washington during the Spanish American War. His copious reports for the censuses of 1900, 1905 and 1910, as expert agent in charge of chemical

industries, are invaluable for their wealth of historical and statistical information. He served also at various times as consulting expert for the U. S. Geological Survey, the U. S. Forestry Service and the Civil Service Commission, and was chairman of the advisory committee of the American Railway Association for drafting regulations on the safe transportation of explosives. He was chairman of the Committee on Explosives of the American Society of Testing Materials and also of the Committee on Explosives Investigations of the National Research Council. His name is writ large in the history of the American explosives industry.

No less extensive were Munroe's services for the numerous scientific societies of which he was a member. In 1873 at the meeting of the American Association for the Advancement of Science in Portland, Maine, he was secretary of a group of distinguished chemists (among whom were seven future presidents of the American Chemical Society) who petitioned the association for the formation of a subsection of chemistry. This was a recognized feature of the association until 1881, when it was made a full section. Munroe was the last survivor of this original group of founders of Section C. He was also the last surviving charter member of the American Chemical Society (founded in 1876), which honored him with its presidency in 1898. His services to this body, of which he was a life member, were of the highest order. In the early days when the American Chemical Society, because of mismanagement, was threatened with disruption, no less than seven of its future presidents having resigned, it was Munroe who, adhering loyally to his membership, organized the first local section and the first general meeting of the society at Newport, which, with the other reforms that he helped to initiate, restored harmony to the shattered organization and set it for the first time on the path that led to its subsequent phenomenal growth. When collaborators were lacking to write the chapter on "Industrial Chemistry" for the fiftieth anniversary number of the *Journal of the American Chemical Society* in 1926 it was Munroe again who saved the day by voluntarily assuming this extra burden. He served continuously as associate editor on explosives for *Chemical Abstracts* from the first issue of this journal in 1907 until death terminated the activity of his pen.

In addition to the various domestic and foreign chemical societies to which he belonged, Munroe was a member of the American Association for the Advancement of Science, the American Philosophical Society and the American Academy of Arts and Sciences. He was a recipient of numerous honors, among which were a membership in the Turkish Order of Medjidieh and a decoration of the Order of Leopold from Belgium.

In his social relations, Munroe was a prince among men. Within his large circle of friends at the Cosmos Club (of which he was president in 1913–1914) cordiality and good will radiated from him as light from the sun. Like his old college chums, F. W. Clarke and H. W. Wiley, he had a jovial temperament, and those who were so fortunate as to join this famous trio of Harvard men in one of their festive gatherings will always remember the spontaneous flow of wit and merriment.

On June 20, 1883, Professor Munroe married Mary Louise Barker, daughter of the late Professor George F. Barker, also a charter member and past president of the American Chemical Society, and just fifty years later he and Mrs. Munroe, surrounded by their five children and numerous grandchildren, celebrated their golden wedding anniversary. Munroe's life was singularly happy and productive. He was the last brilliant example of the old school chemist who cultivated his science upon all its sides, who saw it steadily and saw it whole. To him may be applied those words of Ariosto, "Nature made him and then broke the mould."

C. A. BROWNE

RECENT DEATHS AND MEMORIALS

DR. HENRY VANPETERS WILSON, Kenan professor of zoology at the University of North Carolina and since 1891 head of the department until his retirement two years ago, died on January 4 in his seventy-sixth year.

DR. FABIAN FRANKLIN, professor of mathematics in the Johns Hopkins University from 1879 to 1895, later editor of the *Baltimore News* and associate editor of the *New York Evening Post*, died on January 8 at the age of eighty-six years.

DR. LOUIS ISRAEL HARRIS, health commissioner of New York City from 1926 until 1928, died on January 6 at the age of fifty-six years.

DR. WARREN KING MOOREHEAD, professor emeritus of Phillips Academy at Andover, Mass., and curator of its museum, died on January 5 at the age of seventy-two years.

PROFESSOR H. J. BAKER, director of the extension service for the New Jersey Agricultural Experiment Station at Rutgers University, died on January 6 at the age of fifty-three years.

DR. GEORGE BARGER, Regius professor of chemistry at the University of Glasgow, known for his work on alkaloids and the synthesis of thyroxin, died on January 6. He was sixty years old. Dr. Barger lectured at Cornell University and at the Johns Hopkins University in 1928.

SCIENTIFIC EVENTS

THE OCEANOGRAPHIC VESSEL CULVER OF THE BERMUDA BIOLOGICAL STATION

THE oceanographic vessel *Culver* has arrived at the Bermuda Islands from England for a five-year survey in cooperation with the Bermuda Biological Station and the Woods Hole Oceanographic Institution to measure the oscillation of the Gulf Stream. It is hoped that the survey may help to avert the next great drought in the United States Mid-West, predicting it in time to avert disastrous results to United States farming, and that it may also prove an aid to commercial fishermen in determining movements of fisheries in European waters.

The *Culver* is especially equipped for the Biological Station. It was purchased and refitted with a grant from the Development Commission of Great Britain. Through the Royal Society of London an additional grant may be made for the next five years for the operation of the vessel.

Professor Walter Garstang and Dr. Robert Gurney, of the University of Oxford, spent some time at the Bermuda Biological Station three years ago and returned to England impressed with the possibilities of the station for oceanographic work.

Professor Garstang is reported to have said:

> We went back to England with the thought that the English people ought to be told something about the features of the Bermuda colony which they seemed to have forgotten. We told them that Bermuda was a beautiful island perched on a pinnacle in the middle of the most interesting of all oceans, surrounded by deep waters which could be reached within an hour or less from the laboratory. We have been able to prove what we said. We caught a little creature—of no practical importance but very important scientifically—which had been caught only once before on a German ship which made an expedition into the Indian Ocean and southern Atlantic.

When Dr. Garstang and Dr. Gurney first returned they thought that if a small vessel could be obtained to be used more or less as a tender for the station, it would suffice. However, the Royal Society and the Development Commission favored a larger scheme, with the result that an ocean-going vessel was acquired.

The *Culver* is a converted yacht, 83 feet overall, with a beam of 19 feet, 3 inches. A spacious saloon will serve for a wardroom and a laboratory, and there are accommodations for three scientific men, the captain and the engineer, with crew quarters forward. The displacement of the vessel is 100 tons, and she is equipped with a new Diesel engine as an auxiliary to her sails. There is a large winch, operated from the vessel's main engines, for biological work. On the winch's cable is wound 3,500 fathoms of wire. For the hydrographic work there is an electrically driven winch forward—also with 3,500 fathoms of wire. The larger winch will be used for the nets; the smaller one will be used to let down water bottles in which samples of the ocean and temperatures, at various depths, will be taken.

The *Culver* will begin her work in the Gulf Stream. A double program, consisting of chemical and physical work and purely biological work, is planned. The former will be done in conjunction with the *Atlantis* within an area of sixty miles from Bermuda; the scientific men aboard the *Culver* will investigate local offshore currents. Quarterly cruises are planned for at least three or four years. The *Culver* will not be away from the station more than a week at a time, as it is necessary to get specimens into the laboratory quickly, and she will not go more than 100–150 miles from the islands. Entirely apart from the local aspects of the work are the hydrographic observations. Probably once a fortnight, but certainly once a month, the *Culver* will go to one or two defined stations, possibly 100 to 150 miles out, on this side of the Gulf Stream.

FARM RESEARCH LABORATORIES OF THE U. S. DEPARTMENT OF AGRICULTURE

DIRECTORS for the four farm research laboratories to be established by the Department of Agriculture to search for new and wider industrial outlets and markets for agricultural commodities have been announced by Dr. Henry G. Knight, chief of the Bureau of Chemistry and Soils. Dr. H. T. Herrick was recently appointed assistant chief of the bureau, having general supervision of the chemical and chemical engineering work in all four laboratories.

Each laboratory will have a broad circle of important contacts with industries, institutions and agricultural experiment stations. These will be largely in the hands of the individual directors. Included in the laboratory staff, which will be composed of several hundred people, there will be experts in many branches of science and technology, as well as fairly large business and service departments.

Dr. Knight pointed out that "The importance of the scientific studies undertaken in these laboratories demands that the director be a man with a record of successful research achievements plus the ability to inspire work of the highest professional character in others," and that "The men named have shown during their years of service with the department that they possess these desirable qualifications." They are as follows:

Northern Laboratory

The laboratory for the northern area, which includes the states of Illinois, Indiana, Iowa, Kansas, Michigan,

Minnesota, Missouri, Ohio, Nebraska, North and South Dakota and Wisconsin, will be under the direction of Dr. O. E. May, until recently director of the Soybean Industrial Products Laboratory at Urbana, Illinois.

Southern Laboratory

The laboratory for the southern area, which includes the states of Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Oklahoma, South Carolina and Texas, will be under the direction of D. F. J. Lynch, formerly chief of the Agricultural By-products Laboratory at Ames, Iowa.

Eastern Laboratory

The laboratory for the western area, which includes the states of Connecticut, Delaware, Kentucky, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, Tennessee, Vermont, Virginia and West Virginia, will be under the direction of P. A. Wells, of the Industrial Farm Products Research Division of the Bureau of Chemistry and Soils.

Western Laboratory

The laboratory for the western area, which includes the states of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming, will be under the direction of Dr. T. L. Swenson, of the Food Research Division of the Bureau of Chemistry and Soils.

ANNUAL REPORT OF THE DIRECTOR OF FIELD MUSEUM, CHICAGO

THE annual report of Dr. Clifford C. Gregg, director of Field Museum, Chicago, states that from the standpoint of service to the public, the year has been one of the most active and successful in the history of the institution.

The number of visitors received at the museum in 1938 has been approximately 1,390,000. This is an increase of about 100,000 over the 1937 attendance, which likewise had been more than 100,000 in excess of that registered in the preceding year. The balance of the more than 2,000,000 people brought directly within the sphere of the museum's influence consists of some 500,000 Chicago school children repeatedly reached by the 1,200 traveling natural history exhibits circulated by the N. W. Harris Public School Extension Department of the Museum, and approximately 180,000 children reached through lecturers sent into the schools by the James Nelson and Anna Louise Raymond Foundation of Field Museum.

Of the 1938 attendance, more than 93 per cent. were admitted free of charge, coming on the free days (Thursdays, Saturdays and Sundays), or belonging to classifications such as children, teachers and students who are admitted free on all days. Thus the 25-cent admission fee charged on other days was paid by less than 7 per cent. of the total number.

All departments of the museum made important additions to their exhibits in 1938. Among these are: in the department of anthropology, an entire new hall devoted to Asiatic ethnology; in the department of botany, a diorama reproducing a scene above the timberline in the Rocky Mountains of Wyoming, and in the paleontological division of the department of geology, several new and rare reassembled skeletons of prehistoric animals. Added to the department of zoology are a habitat group of Wedell's seals collected in the Antarctic by Admiral Byrd; groups of the quetzal, the national bird of Guatemala, and of the toucan and the oropendula or giant oriole of the same country, collected by an expedition sponsored by Leon Mandel, of Chicago; a group of storks and their nests, obtained through the cooperation of the Polish-American Chamber of Commerce in Warsaw; a lifelike mount of Su-Lin, famous giant panda of the Brookfield Zoo, which died in April; a habitat group of narwhals, collected off the Greenland coast by Captain Robert Bartlett, and a restoration of the extinct dodo.

In view of the fact that in 1938, as in other recent years, the depression has severely curtailed its budgets, it has been impossible for the museum to appropriate from its own funds for expeditions, the institution, however, was able to carry out an important expeditionary program with contributions from public-spirited Chicagoans. Sewell Avery sponsored four—a zoological expedition to British Guiana, a geological expedition in western and eastern parts of the United States and two botanical expeditions—one to Guatemala and one to Nova Scotia. Stanley Field, president of the museum, made available funds for continuation of the work, begun eight years ago, of archeological excavations of extensive scope and importance in southwestern Colorado. Dr. Wilfred H. Osgood, chief curator of zoology, personally financed and conducted an expedition concerned with biological research in New Mexico. Field work in other localities was conducted by other members of the staff. The museum press issued twenty-seven scientific publications and seven leaflets for lay readers.

THE NEW YORK MEETING OF THE AMERICAN ANTHROPOLOGICAL ASSOCIATION

AT the New York City meeting of the American Anthropological Association, the following officers were elected:

President, D. Jenness.
First Vice-president, J. M. Cooper (1939).
Second Vice-president, E. A. Hooton (1939–1940).
Third Vice-president, W. D. Strong (1939–1941).
Fourth Vice-president, R. F. Benedict (1939–1942).
Secretary, F. M. Setzler.
Treasurer, Bella Weitzner.
Editor, R. Linton.
Associate Editors, M. J. Herskovits, F. H. H. Roberts, Jr., Melville Jacobs.

Executive Committee, R. Redfield, E. C. Parsons, R. H. Lowie.

Representative to Social Science Research Council, R. H. Lowie (1939–1941).

Representative to American Council of Learned Societies, Franz Boas (1939–1942).

Representatives to National Research Council, J. A. Mason, Wendell C. Bennett, Fay-Cooper Cole (1939–1942).

Representatives to Section H, the American Association for the Advancement of Science, E. A. Hooton, C. Osgood (1939).

The following resolution was unanimously adopted at the 1938 annual meeting of the American Anthropological Association.

Whereas, The prime requisites of science are the honest and unbiased search for truth and the freedom to proclaim such truth when discovered and known; and,

Whereas, Anthropology in many countries is being conscripted and its data distorted and misinterpreted to serve the cause of an unscientific racialism rather than the cause of truth;

Be it resolved, That the American Anthropological Association repudiates such racialism and adheres to the following statement of facts:

(1) Race involves the inheritance of similar physical variations by large groups of mankind, but its psychological and cultural connotations, if they exist, have not been ascertained by science.

(2) The terms "Aryan" and "Semitic" have no racial significance whatsoever. They simply denote linguistic families.

(3) Anthropology provides no scientific basis for discrimination against any people on the ground of racial inferiority, religious affiliation or linguistic heritage.

DR. VANNEVAR BUSH, PRESIDENT OF THE CARNEGIE INSTITUTION OF WASHINGTON

DR. VANNEVAR BUSH, vice-president of the Massachusetts Institute of Technology and dean of the School of Engineering, entered upon his work as president of the Carnegie Institution of Washington on January 1. A year ago Dr. John C. Merriam, who has been president of the institution for eighteen years, requested the trustees to release him at the end of 1938 in order that he might resume his research work in paleontology and related fields. Last June Dr. Bush was elected to succeed Dr. Merriam.

Dr. Bush is a native of Everett, Mass., the son of the late Rev. R. Perry Bush, for fifty years a clergyman in the vicinity of Boston. He was graduated from Tufts College in 1913, and in 1916 was awarded the degree of doctor of engineering from Harvard University and the Massachusetts Institute of Technology. Early in his career he held a position in the test department of the General Electric Company, and then returned to Tufts College as an instructor in mathematics, later becoming assistant professor of electrical engineering. In 1932 he received from the college, of which he is a trustee, the honorary degree of doctor of science.

Dr. Bush was invited to join the faculty of the Massachusetts Institute of Technology in 1919 as professor of electric power transmission. He was appointed vice-president and dean of the School of Engineering of the institute in March, 1932. At the same time he was elected a member of the corporation of the institute.

Dr. Bush has been particularly interested in the design of advanced mathematical analyzing instruments and has had charge of a group of research workers which has produced several important instruments of this type. In recognition of work in this field, in 1928 he was awarded the Levy Medal of the Franklin Institute. Recognition has also been given him on account of the design which he developed of an intricate analyzing machine called the differential analyzer. This machine greatly increases the speed of scientific and engineering calculations. Another instrument in this group is the cinema integraph, which is just going into use. For his achievements in the development of methods and devices for the application of mathematical analysis to problems of electrical engineering, the American Institute of Electrical Engineers, in 1926, awarded to him the Lamme Medal. Dr. Bush has made also many important contributions to the improvement of vacuum tubes and has carried out distinguished research in the field of electric power transmission. He has also carried on important studies of transients in machines and dielectric phenomena.

As head of the Carnegie Institution of Washington Dr. Bush will be responsible for administering one of the largest non-governmental research budgets in existence, the current yearly expenditures approximating a million and a half dollars. In preparation for his work Dr. Bush has devoted much time during the past six months to acquainting himself with the organization of the institution and with its work and problems.

SCIENTIFIC NOTES AND NEWS

THE presentation of the Perkin Medal of the American Section of the Society of Chemical Industry to Dr. Walter S. Landis, vice-president of the American Cyanamid Company, was made on the evening of January 6 at the Chemists' Club, New York City. The medal address by Dr. Landis was entitled "Argon."

THE Sylvanus Albert Reed Award for 1938, conferred annually by the Institute of the Aeronautical Sciences for a notable contribution to aeronautical engineering, has been awarded to Professor Alfred V. de Forest, professor of mechanical engineering at the Massachusetts Institute of Technology.

DR. I. M. HEILBRON, professor of organic chemistry at the Imperial College, London, has been awarded the Longstaff Medal of the Chemical Society, London, in recognition of his work in the field of natural products, especially vitamin A and related natural pigments, the anti-rachitic vitamin D and its precursors and the constituents of the fish liver oils and of natural resins of the triterpene group.

PROFESSOR FRANK B. MORRISON, professor of animal husbandry at Cornell University and head of the department, was recently the guest of honor at the annual dinner of the American Society of Animal Production, when his portrait was presented to the society. The painting will be hung in the gallery of men who have achieved fame in agriculture, particularly in animal industry. The award was made "in recognition of his achievements as teacher, research specialist and author."

DR. W. J. DE HAAS, professor of physics in the University of Leiden, has been elected correspondent for the Section of Physics of the Paris Academy of Sciences, in succession to the late Dr. C.-E. Guillaume; I. Holmgren, from 1913 to 1936 professor in the Caroline Medico-Surgical Institute at Stockholm, has been elected correspondent for the Section of Medicine and Surgery, in succession to the late Professor I. Pavlov; M. Paul Wintrebert, professor of comparative anatomy and histology in the Sorbonne, has been made a member of the Section of Anatomy and Zoology, in succession to the late F. Mesnil.

DR. CHARLES E. SPEARMAN, emeritus professor of psychology at the University of London, has been elected a member of the German Academy of Natural Sciences at Halle.

DR. ALBRECHT PENCK, professor of geography at the University of Berlin, has been elected an honorary member of the Geological Society at Berlin.

THE degree of doctor of humane letters will be conferred by Hamilton College on Dr. Gustav Eckstein, professor of physiology in the College of Medicine of the University of Cincinnati.

THE National University of Ireland has conferred the doctorate of laws on Sir Walter Langdon-Brown, emeritus professor of physic at the University of Cambridge. The degree was conferred by E. de Valera, prime minister, the chancellor of the university. Professor Henry Moore, in an introductory speech, said that "while Sir Walter Langdon-Brown's name was familiar to every member of the medical profession through his medical writings and lectures, his repute was high in literary and scientific circles through his philosophical and scientific works."

DR. MALCOLM GOODRIDGE, professor of clinical medicine at Cornell University Medical College and attending physician at New York Hospital, was installed as president of the New York Academy of Medicine at the annual meeting of the academy on January 5. He succeeds Dr. James Alexander Miller.

SIR ROBERT ROBINSON, Waynflete professor of chemistry at the University of Oxford, has been nominated for the presidency of the Chemical Society, London.

DR. JULIUS BAUER, professor of internal medicine and since 1931 in charge of the department of medicine at the University of Vienna, has been appointed clinical professor of medicine in the School of Medicine of the Louisiana State University.

DR. HENRY PINKERTON, assistant professor of pathology at Harvard University, has been appointed professor of pathology and director of the department at St. Louis University. Dr. William Bauer, professor of dental pathology at the University of Innsbruck and director of the Dental Clinic, has been appointed professor of dental pathology.

DR. GEORGE F. STEWART has been named research associate professor of poultry husbandry at Iowa State College. He will work on problems of the cold storage of eggs and poultry meat in the Iowa Agricultural Experiment Station.

DR. ULYSSES P. HEDRICK, who retired as director of the New York State Agricultural Experiment Station in January, 1938, has been given the title of director emeritus of the station.

FRANK T. BELL, who has been commissioner of the Bureau of Fisheries for five years, will retire on March 21.

DR. VANNEVAR BUSH, president of the Carnegie Institution of Washington, previously vice-president and dean of engineering of the Massachusetts Institute of Technology, has been elected to life membership on the corporation of the institute.

PROFESSOR ELMER A. STARCH, a member for the last twelve years of the department of agricultural economics of the Montana State College and now director, has been appointed coordinator of programs for the U. S. Department of Agriculture. He took up the work on January 1.

EARL CHURCH, associate professor of photogrammetry in the College of Applied Science of Syracuse

University, has been appointed a member of the Advisory Board on Maps and Surveys by the New York State Planning Council.

DR. FLOYD K. RICHTMYER, professor of physics at Cornell University and dean of the Graduate School, has been elected secretary of the Association of American Universities for a five-year term. Heretofore, the officers of the association have been assigned to universities and not to individuals.

DR. ARNO VIEHOEVER, research professor of biology at the Philadelphia College of Pharmacy and Science, has been made scientific adviser to the Government of Siam. While there he will be affiliated with the Ministry of Economic Affairs and with Dr. Toa Labanukrom, director general of the Department of Science. He will organize and direct a special research unit, to explore and utilize domestic curative and nutritional agents.

DR. HARRY PLOTZ, of the Pasteur Institute, Paris, has been appointed chief of service in charge of virus research.

SIR RICHARD GREGORY, retiring editor of *Nature*, who has been visiting the United States at the invitation of the Carnegie Institution of Washington, sailed for England on January 5. Sir Richard delivered the Elihu Root lecture at the institution on December 8 on "Cultural Contacts of Science." While in the United States he gave addresses before a general session of the American Association for the Advancement of Science at Richmond, at Harvard, Columbia and the Johns Hopkins Universities, and elsewhere.

DR. G. C. ANDERSON, secretary of the British Medical Association, sailed on December 28 for a tour of the West Indian branches of the association. He will visit Barbadoes, Grenada, Trinidad and Jamaica, and will return to England about the beginning of March. Dr. Anderson's visit, it is stated, is in conformity with the policy of the association of maintaining personal contact as opportunity offers with its branches overseas.

DR. C. P. MCMEEKIN, of Mercer Agricultural College, New Zealand, recently inspected experimental work being done at the Agricultural College at Davis of the University of California and lectured to staff members of the division of animal husbandry. Dr. McMeekin has been working at the University of Cambridge during the past year.

FORMER PRESIDENT HERBERT HOOVER and Dr. Harvey N. Davis, president of the Stevens Institute of Technology, will be guest speakers at the thirty-sixth annual reunion dinner of the Alumni Association of the institute, which will be held on January 30 at the Hotel Astor, New York City.

DR. EDWIN J. COHN, professor of biological chemistry at the Harvard Medical School, will deliver the fourth Harvey Society lecture of the current series at the New York Academy of Medicine on January 19. Dr. Cohn will speak on "Proteins as Chemical Substances and Biological Components."

DE LAMAR LECTURES of the School of Hygiene and Public Health of the Johns Hopkins University will be given on February 14 by Dr. G. R. Minot, professor of medicine at Harvard University, on "Anemia," and in April by Dr. Edward Stuart Russell, director of Fishery Investigations, Ministry of Agriculture and Fisheries, London, honorary lecturer in animal behavior at University College, on "Fish Populations and the Effect of Fishing." Previous lectures in the present series were given by Dr. Rupert B. Vance, research professor, Institute for Research in Social Science, University of North Carolina; Dr. Carl Ten Broeck, The Rockefeller Institute for Medical Research; and Dr. Martha Eliot, assistant chief of the Children's Bureau, U. S. Department of Labor.

THE annual joint meeting of the Institute of Radio Engineers and the International Scientific Radio Union (American section) will be held at Washington, D. C., on April 28 and 29. Other scientific societies meeting in Washington during the same week include the National Academy of Sciences, the American Physical Society and the American Geophysical Union. Papers on the more fundamental and scientific aspects of radio will be presented. The program will be published in the April issue of the *Proceedings* of the Institute of Radio Engineers. Titles of papers available for presentation should be submitted to the committee not later than February 21. It is desirable that abstracts of not over 200 words be submitted with the titles. Correspondence should be addressed to S. S. Kirby, National Bureau of Standards, Washington, D. C.

DISCUSSION

THE UTILIZATION OF MICROFILMS IN SCIENTIFIC RESEARCH

THE procedure usually followed by research workers in collecting information upon a given subject is to peruse first the abstract journals and, having obtained references to previous work, to consult the original papers. Since scientific periodicals can usually be found only in libraries and must be read there or borrowed only for brief periods, it is necessary to make extensive notes or copy as much of each paper as may be desired for future use.

Occasionally it will be possible to obtain reprints of some of the original papers, hence the research worker may assemble upon a given subject quite a variety of

printed papers and hand-written notes. To these it is now becoming necessary to add the new and entirely different microfilm records which are becoming available in increasing quantities.

Microfilms are photographs in reduced size upon 35 mm moving picture film, of the printed pages of bound and unbound volumes. They have been made since November, 1934, by Bibliofilm Service of Washington. This non-profit organization is conducted by cooperative agreement in the libraries of the U. S. Department of Agriculture, Army Medical, Geological Survey and Bureau of Standards. The price is 1 cent per page plus 20 cents service charge for each article copied. They can be read by means of a small hand magnifier obtainable from Science Service of Washington for $1.50 or with the aid of a highly perfected desk projector, which was developed by cooperation between Science Service, the Chemical Foundation, the U. S. Navy and others, and is now available commercially at about the price of a typewriter.

The greater part of original scientific research is published in the form of brief accounts, not exceeding ten pages in length. Such reports may usually be copied upon less than five microfilm spaces of a total length of about 8 inches. Thus one obtains relatively short lengths of film which it is necessary to file with a variety of printed and written records.

Since the text reproduced upon microfilms can not be read with the naked eye, it is necessary to provide classifying information or notes in regard to each film, in characters which can be read directly. If this information is written upon sheets of paper and the film itself fastened to these sheets, they may be filed with similar records in whatever manner is most convenient, without loss or displacement of the film. In those cases where the length of the film is greater than that of the paper, it may be cut in two or more pieces. The reading magnifiers and projectors now available have film holders in which even very short lengths of film may be inserted, and the perforations along their edges provide convenient holes for fastening the several short pieces to their classifying sheet.

By this method microfilm can conveniently be filed and kept in exactly the same manner employed for other such records. They therefore not only offer no unusual difficulties in respect to their use and conservation, but provide far more complete and compact records than can be assembled in any other way.

One of the principal advantages of microfilms is that they relieve the research worker of the task of making transcriptions of the original literature. The inconvenience arising from errors or incompleteness in such records is entirely avoided. With a microfilm copy at hand it is never necessary to make a second trip to the library or borrow the periodical for completing the notes previously made.

Another very great advantage is that they permit one to make the detailed study of each paper in connection with all the others collected upon the same subject, instead of requiring that this study be made at the time the paper is available for preparing the digest or transcript of it for future use.

By means of microfilms one is relieved of the fatigue incident to assembling and handling large numbers of heavy and unwieldy volumes. Furthermore, since these volumes do not leave the library, no one who desires to consult them there is ever deprived of their use. With a complete collection of microfilm copies of all available papers upon a given subject, one is independent of further library service. Since, unlike books, they do not have to be returned, it is never necessary to hurry or slight one's examination of any paper, especially those which it is necessary to study with unusual care.

The compact form of microfilms makes it possible to take them, together with a small microfilm viewer, wherever one goes and consult them at whatever time or place is found most convenient. Thus one may profitably make use of spare moments which otherwise could not be devoted to the research problem upon which he happens to be engaged.

Microfilms offer the best possible method for making extensive compilations of scientific literature. They permit the complete assemblage of all pertinent reports before their critical study and arrangement of the facts in the logical order required for their presentation. It was only through their use that the writer found it possible to undertake a fourth revision of his compilation of "Solubilities of Inorganic and Organic Compounds." The literature on this subject is so extensive that its collection, classification and editing would have been a task beyond his power without the aid of microfilms.

Finally, not the least of the advantages of microfilms is their very modest cost to the individual. In fact, up to the present, those who have made use of the Bibliofilm Service operating in the library of the U. S. Department of Agriculture, have received microfilms at considerably less than their actual cost. Fortunately for the progress of research, the Chemical Foundation and both the Rockefeller and Carnegie Foundations have recognized the advantages of microfilms to the advancement of science, and have generously contributed to the expenses of developing and operating Bibliofilm Service. It is expected that with the continued expansion of the Service the present low price will be sufficient to cover the actual cost of furnishing microfilms to research workers.

Microfilm copying such as has been developed by

Bibliofilm Service now operating in four Washington libraries puts at the disposal of every one doing serious research the resources of the most complete collections of scientific literature in the United States. From the standpoint of original literature microfilms places those doing research in the most isolated institutions on an equality with those working in immediate proximity to complete collections of scientific periodicals. It may be expected therefore that many who have hitherto been prevented from undertaking research for want of proper library facilities, will now find it possible to devote themselves to the numberless scientific and technical problems awaiting solution.

ATHERTON SEIDELL
NATIONAL INSTITUTE OF HEALTH
WASHINGTON, D. C.

IMPROVEMENT OF SCIENCE INSTRUCTION

THE American Association for the Advancement of Science Committee on the Improvement of Science in General Education[1] held a meeting at Chicago on December 3 and 4, on one aspect of which a preliminary report has already been made.[2] Some of its findings may be of interest to readers of SCIENCE.

Of 2,565 inquiries sent out last May, seeking information on what college and university teachers of science were thinking and doing about adapting their offerings to the requirements of *general education,* in distinction from *specialist education,* more than 1,200 replies had been received. Eleven hundred of these had been analyzed to date, yielding, among other things, the following information.

Of those replying, 64 per cent. were doubtful or more than doubtful about the value of the conventional introductory college courses in the various sciences to non-majors. 70 per cent., however, feared that attempts so to modify first-year courses as to make them of greater value to non-majors might be attended by the danger of making the courses superficial.

There seemed, nevertheless, to be little disposition to maintain the *status quo,* for 86 per cent. had made changes in their introductory courses within the last five years, of sufficient extent to justify report.

Insufficient motivation for a study of teaching problems seemed to be regarded as a handicap, for 62 per cent. felt that the disproportionate emphasis placed on publication of results of "pure research" as a basis for professional recognition and advancement had retarded the development of a real concern about and research upon teaching problems in the introductory courses in the sciences.

77 per cent. expressed the need for a discussion and clarification of the issue of the place of science in general education at the college and university level.

The fact that only a little over one third of a mature group of college teachers of the sciences possesses unqualified confidence in the value of the traditional first-year courses to non-majors raises several questions. What do they think is wrong with these courses? Along what lines would they undertake improvement? What has brought about their impression of the inadequacy of the first-year science courses to the purposes of general education? These are not easy questions to answer, but the committee is deeply concerned with ways and means of trying to answer them.

Questionnaires are notoriously "slippery" ways of acquiring information, and it was only after some hesitation that a questionnaire was utilized as a first probe, primarily because it was the quickest way of getting started. Other channels of information are being opened up. Special visits have been made by representatives of the committee to 115 science departments where significant experimentation on teaching methods seemed to be under way. An extended bibliography of publications on the relation of the sciences to general education, indexed and annotated, will be prepared for the use of the committee. In addition, as indicated in previous communications, the committee solicits correspondence with any who have teaching experiments under way or who are contemplating such.

Perhaps it should be emphasized that this committee's primary responsibility is to chart the field; only secondarily, if at all, to try directly to solve the problems therein. Some of the problems which loom are, in fact, beyond the ability of any one group to cope with. Hence the wisdom of the founding committee of the American Association for the Advancement of Science, which provided, among other things, that this committee should clarify and define the problems involved in teaching the sciences as a part of the program of general education; serve as a clearing house for coordinating the activities of the several agencies now at work on parts of the whole problem as well as new agencies which may be initiated for the improvement of science teaching; act in an advisory capacity on any studies approved by it and supported through it; require and coordinate reports of such studies and provide for publication of the findings.

LLOYD W. TAYLOR
OBERLIN, OHIO

THE BENLD METEORITE, ILLINOIS NO. 2

ON September 29, 1938, between the hours of 9:00 and 9:10 A.M. occurred the second meteorite fall ever to be recorded within the state of Illinois. This important event took place in the south edge of the town of Benld, Macoupin County, near the southeast corner of the S W ¼; S W ¼; Section 31, Township 8 North; Range 6 West of the 3rd P.M. (89° 48′ 52″ ± W. Long.; 39° 05′ 14″ ± North Lat.)

[1] SCIENCE, 87: 454, 1938.
[2] SCIENCE, 88: 588, 1938.

In falling this meteorite penetrated the roof of a frame garage and the top of a Pontiac coupe therein, making a neat hole in the cushion of the car to the right of the driver's seat. It also broke the floorboard beneath the seat, and made a slight dent in the car's muffler. The meteorite itself, however, did not hit the ground, as it had become so entangled in the springs of the cushion that it was snapped back up into the cushion by the recoil of the springs.

When discovered and retrieved by the owner the same afternoon, it was found to be roughly prismatic (almost rectilinear) in outline, with dimensions of approximately $110 \times 90 \times 80$ mm. It weighed 1,770.5 grams in air, (after two small fragments of undetermined weight had been removed), and possessed a S. G. of 3.69. Its outer surface was entirely covered with a jet black velvety crust from $\frac{1}{2}$ to 1 mm in thickness. Its interior exhibited a dark gray surface, with chondrules well developed, speckled freely with bright metallic grains of a silvery luster. From weight and appearance it would classify as a typical aërolite.

By the perfect alignment of the holes made in the roof, car and seat, the final end course of the meteorite was determined to be 64° 46′ east of north and at an elevation of 77° 31′ above the horizontal (12° 29′ from vertical). Until more distant observations on its course are obtained, the announcement of its positive direction, radient and velocity must be held in abeyance.

The property upon which the meteorite fell belongs to Mr. Edward McCain, which makes him the owner of the specimen. While it landed with a roar which sounded like "an airplane going into a power dive, and ending in a crash," no one has been interviewed who actually observed its passages through the air. It struck, however, within approximately fifty feet of Mrs. Carl C. Crum, who was working in her yard, just across the alley, at the time. She reported that she could see no smoke clouds and observed no fumes. Thinking that a "plane" had crashed into the rear of their barn, Mrs. Crum rushed out into the alley, and was greatly perplexed on finding no apparent damage to the building. The roof of the garage through which the stone actually fell was so oriented with respect to her position that she was unable to see and observe the hole in the roof from the spot where she was working.

The sound was also heard by Mrs. McCain, who was out pumping water at the time, but somewhat farther from the garage. Several neighbors who were indoors also heard what they took to be an airplane passing over, but "thought nothing of it." This occurrence is certainly unique in several respects, as we believe it to be the first authentic case of any meteorite ever striking an automobile, or for that matter a vehicle of any kind; and the first where its end course could be accurately measured from three established points penetrated in its fall. We also believe Mrs. Crumb came nearest to being actually hit by a meteorite of any person on record in this country. So far as is known, this was a lone individual stone, there having been, to date, no report of others having fallen in the vicinity at the time.

BEN HUR WILSON

JOILET, ILL.

WHAT DID THE BLUE JAY DO WITH THE NUT?

THIS afternoon (November 21) I observed the following quick sequence of events, which occurred on my front lawn:

1:45. A grey squirrel, answering my tapping signal, ran up a rustic incline which leads to a window box, to secure a nut (paper shell pecan) which I offered him through an open window.

1:46. This squirrel scampered back to the lawn to a point about 15 feet away. He buried the nut and raked a brittle oak leaf over it.

1:47. The squirrel returned to the window box for a second nut. Immediately a blue jay flew down to the precise spot where the first nut had been buried, pecked vigorously through the oak leaf into the soil, and in about 30 seconds seized the nut in his bill and disappeared with swift and sudden flight into a towering elm near by. What did he do with the nut?

I do not wish to worsen the reputation of the blue jay, but the incident seems worth reporting.

ARNOLD GESELL

NEW HAVEN, CONN.

SPECIAL ARTICLES

MAMMARY CARCINOMA IN THE RAT WITH METASTASIS INDUCED BY ESTROGEN*

IN a previous communication pathologic changes in the mammary gland of the rat induced by estrogen and other hormones have been reported and an early comedo carcinoma of the mammary gland illustrated in a castrated female injected with 200 gamma of estrone.[1] The changes in this animal were not discussed, however, because confirmation of the diagnosis of cancer was lacking at the time. Since this communication mammary cancer in the rat has been in-

* Aided by grant from the Anna Fuller Fund.

[1] E. B. Astwood and C. F. Geschickter, *Arch. Surg.*, 36: 672, 1938. Figs. 8 and 10 are whole mounts and paraffin section depicting early adenocarcinoma. The legends compare the condition to a phase of Schimmelbusch disease in the human.

duced in 26 animals. The animals used were a pure strain of albinos, fed on a standard diet. They have been maintained by breeding in this laboratory since 1934 and to date in a colony of 2,000 rats, spontaneous mammary cancer has not appeared in untreated animals. Cancers have been obtained in both male and female castrates and noncastrates, with varying amounts and methods of dosage and metastasis to the lungs and mediastinal lymph nodes has been obtained. The protocol of one of these rats is given below:

Rat number 1274—Born November 22, 1937—Female not castrated.

Fifty gamma of estrone daily (excluding Sundays) November 23rd to December 29th (37 days).

Twenty-five gamma estrone twice daily (excluding Sundays) December 30th to March 21st (70 days).

Estrone pellet 4 milligrams March 21st.

Estrone pellet 2 milligrams June 16th, 1938. Autopsied November 3rd, 1938 (346 days old).

The entire abdominal wall was covered by mammary tumors for a period of over six weeks prior to death. Sections of the mammary cancer show areas of adenocarcinoma arranged in coils and lining duct channels. The epithelial cells are oval and compressed and contain numerous mitotic figures. In places the cancerous epithelium is more of the transitional type and in other areas shows squamous cell metaplasia. Nearly all the mammary tissue is replaced by cancer. The mediastinal lymph nodes are in a large measure replaced by solid cancerous tissue. The lungs in addition to terminal pneumonia show numerous small metastases similar to the primary tumor.

The uterus is lined by epidermoid tissue; the canal is dilated, but there is no pyometrium. The lining of the fallopian tubes is hyperplastic and there is an adenoma at the fimbriated ends of both tubes, probably in the parovarian. The ovaries are atrophic and show minute follicles. The transitional lining of the renal pelvis is thickened; the kidneys are otherwise negative. The adrenals showed atrophy of the external cortical layer, and the pituitary showed a large chromophobe adenoma. In the gross the hypophysis was about three times its normal size. The other organs were essentially negative.

In the present series of experiments 85 rats were subjected to various types of estrogenic treatment, the chief object being to determine the nature of the changes preceding the formation of mammary cancer and the most effective method of producing mammary carcinoma in the rat.

These experiments (see Table 1) indicate that a daily dosage of 200 gamma of estrone injected intramuscularly is most suitable for the detailed study of the mechanism of cancer production in the mammary gland of the rat. Microscopic cancer occurs within 150 to 200 days with such dosage.

TABLE 1

MAMMARY CANCERS IN THE RAT PRODUCED BY ESTROGEN

Experiment number	No. of rats*	Estrone dosage	Number of cancers produced	Age at beginning of treatment	Days required to produce cancer
1	4†	50 gamma daily	3 males	26 days	534–565
2	8†	100 gamma daily	3 males 1 female	37 days	359–400
3A	13†	200 gamma daily	5 females	21 days	150–200
3B	4†	200 gamma daily plus testosterone	1 female	25 days	191
4A	28‡	25 gamma twice daily plus pellets	6 females	1st day	150–247 17 still living
4B	18†	25 gamma twice daily plus pellet	4 females	1st day	208–240 7 still living
5	11‡	Pellets	2 females	1st day	23–43 11 still living
	86		19 females 6 males	Earliest cancer in 23 days	

* Includes males and females.
† Castrated.
‡ Not castrated.
Pellets are crystalline estrone in 2 to 3 milligram amounts. Experiments 4A and B and 5 are still in progress, the animals being between the 205th and 400th day of treatment. The cancers listed are only those which have been microscopically studied. The estrone used was ketohydroxyestrin supplied by E. R. Squibb and Sons.

Cancer can be produced by the injection of smaller doses in 500 to 600 days with 50 gamma and in 350 to 400 days with 100 gamma. They can be obtained more quickly by implanting the crystalline hormone in the form of pellets (25 to 50 days).

With injections of the hormone in oil once daily, the time required is inversely proportional to the size of the dose, the total dose being relatively constant. With the use of pellets a higher and more constant rate

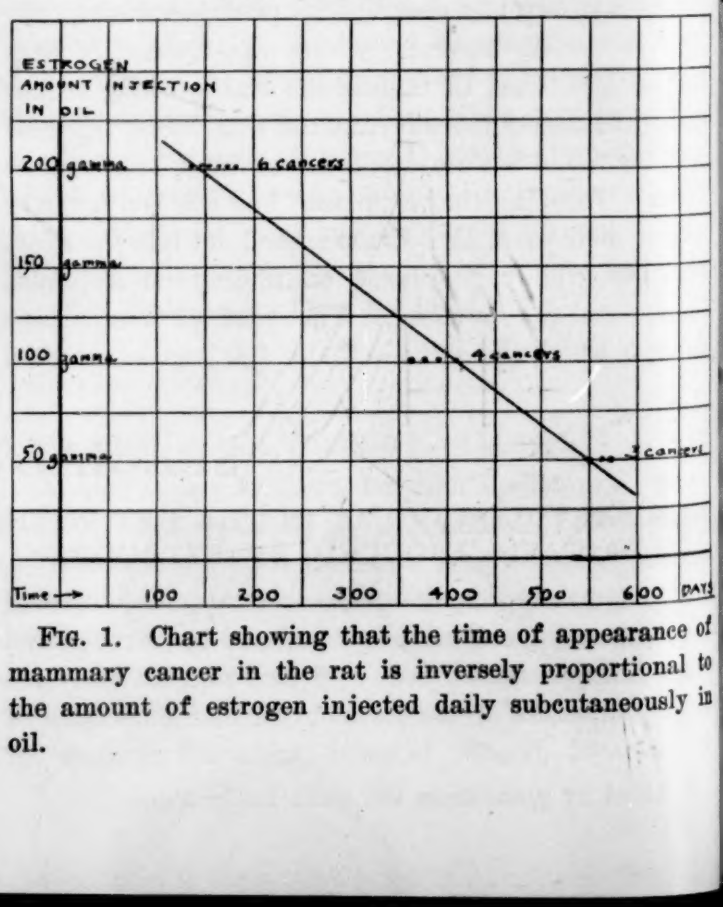

FIG. 1. Chart showing that the time of appearance of mammary cancer in the rat is inversely proportional to the amount of estrogen injected daily subcutaneously in oil.

of absorption is obtained and the cancer is produced sooner and with a smaller total dose. With pellets a total of five to ten milligrams is sufficient, whereas with injections in oil a total of 30 to 40 milligrams is used.

In a parallel group of experiments, an attempt has been made to induce mammary carcinoma of the rat with other estrogenic substances. The compounds used have been estradiol, estradiol dipropionate and diethyl-stilboestrol. The experiments are still incomplete but cancer has been obtained in one rat injected with 200 gamma of diethyl-stilboestrol daily for 100 days. This cancer induced with diethyl-stilboestrol is significant because the substance has the physiological action of estrone but is not a sterol. This suggests that the mammary cancers induced in the rats by the injection of estrogenic substances are due to the physiological changes produced rather than to the cancerogenic nature of the chemicals used.

CHARLES F. GESCHICKTER
SURGICAL PATHOLOGICAL LABORATORY,
DEPARTMENT OF SURGERY
JOHNS HOPKINS HOSPITAL AND UNIVERSITY

FUMARIC ACID FORMATION ASSOCIATED WITH SEXUALITY IN A STRAIN OF RHIZOPUS NIGRICANS

A DEFINITE relation has been known for some time to exist between the sexuality of fungi belonging to the *Mucorales* and certain biochemical reactions exhibited by them. Thus Satina and Blakeslee[1] demonstrated a high degree of correlation of the sexual nature of these fungi with such properties as reducing power of cell extracts toward $KMnO_4$ and tellurium salts, Manoilov's reaction, catalase content, etc. On the other hand, these authors could not establish any differentiation based on the carbohydrase systems of the various races. The differences in reactions obtained for the male and female races were in almost all cases quantitative rather than qualitative.

The present note concerns one strain of *Rhizopus nigricans* whose male and female races are distinct by virtue of the *possession or the complete lack of a certain specific physiological mechanism,* namely, the enzyme system by which the organism produces fumaric acid when grown on a glucose-mineral solution (Table I). So far as the authors are aware no similar case has yet been reported. The male race (−) was tested under a variety of experimental conditions and never was found to form fumaric acid, whereas the female race (+) produced this acid abundantly. Further, despite the fact that a large part of the glucose consumed was transformed by the plus race into fumaric acid, this organism was able to utilize the energy much more efficiently and synthesize much more cell substance than its male homologue, as measured by nitrogen consumption.

The ability to form fumaric acid is but one of the many specific reactions of which this group of fungi

TABLE I

FUMARIC ACID PRODUCTION BY MALE (−) AND FEMALE (+) RACES OF A STRAIN OF RHIZOPUS NIGRICANS*

	Female race (+)	Male race (−)
Glucose consumed, gm.	6.472	6.662
Fumaric acid produced, gm.	2.059	0
Conversion, per cent.	31.8	0
NH_3–N consumed in culture, mgm.	80.7	40.6
Calcium in solution due to organic acids, mgm.	722.1	49.6
Fumaric acid equivalent, calculated from Ca^{++}, gm.	2.094	.....
Per cent. of total acid as fumaric	98.3	.....

* Medium used: 200 cc portions of 5 per cent. glucose-mineral solution containing 82.0 mgm NH_3–N; incubation, 15 days at 28° C.

is capable, and it is not impossible that sexual differences within this group may eventually be correlated with other as yet unstudied physiological processes. It must not be inferred, however, that the above results are characteristic of all or even a significant number of sexual pairs of *Rhizopus;* another pair tested simultaneously yielded no such dissimilarity and even members of the same race differed in this respect. This would seem to indicate that fumaric acid formation is not at all a property specific to a race but may rather be attributed to some biological characteristic giving rise to strain specificity.

A detailed study of the process of fumaric acid production and its possible function in the mechanism of energy utilization by different species of *Rhizopus* will be published shortly.[2]

JACKSON W. FOSTER
SELMAN A. WAKSMAN
NEW JERSEY AGRICULTURAL EXPERIMENT STATION,
NEW BRUNSWICK, N. J.

GAS BUBBLES AS NUCLEI FOR "OOLITES"[1]

SPHERICAL bodies of calcium carbonate, with some of the characteristics of oolites, are now forming in a swimming pool supplied with water from one of the Pinkerton Hot Springs in southwestern Colorado. Five large springs and several smaller ones occur within an area of about a quarter of a square mile on the west side of the Animas River, about 12½ miles north of Durango. They appear to issue from fissures in the Ouray limestone, but the points of emergence are obscured by cones of travertine that have been deposited by the spring waters. The year-round tem-

[1] S. Satina and A. F. Blakeslee, *Proc. Nat. Acad. Sci.*, 12: 191–96, 197–202, 1926; 13: 115–22, 1927; 14: 308–16, 1928.

[2] The authors are indebted to Dr. A. F. Blakeslee for supplying cultures used in these investigations.

[1] Published by permission of the Director, Geological Survey, United States Department of the Interior.

perature of about 87° F.[2] and the uniformity of flow regardless of seasonal variations in precipitation indicate that the water rises from considerable depth.

The spring waters contain large amounts of calcium bicarbonate and salt (sodium chloride) and considerable quantities of other constitutents. The figures in Table 1 are an average of two very similar analyses of waters from two of the springs.

TABLE 1

COMPOSITION OF WATER FROM PINKERTON HOT SPRINGS*

Constituent	Milligrams per liter (Approximately parts per million)
Silica (SiO_2)	37
Ferric oxide + alumina ($Fe_2O_3 + Al_2O_3$)	Tr. – 14.1
Calcium (Ca)	513
Magnesium (Mg)	37
Sodium (Na)	665
Potassium (K)	100
Bicarbonate radicle (HCO_3)	1,255
Sulphate radicle (SO_4)	636
Chloride radicle (Cl)	945
Total dissolved solids	3,805
Excess carbon dioxide (CO_2)	453

* H. A. Curtis, in R. D. George, *op. cit.*, pp. 291–292.

The water from one of the springs is led through an iron pipe into a large concrete-lined swimming pool. Calcareous tufa, stained yellowish brown with iron oxide, is deposited rapidly and by the end of the summer tourist season, which lasts from June through September, the walls and floor of the pool are coated with 6 inches or more of the material. The pool is scraped clean once a year.

"Oolites" were found forming along the sloping floor of the pool in the early summer of 1935. They were most abundant where the water was less than 6 inches deep. They ranged from a fraction of a millimeter to about 2 millimeters in diameter and consists of film or skins of calcium carbonate that enclosed bubbles of gas, almost certainly carbon dioxide. The precipitate was very thin or absent on the tops of the mineral "balloons," but thick below. Many of the growths assumed the shape of tiny wine glasses, with slender stems 2 to 3 millimeters in height supporting the gas bubbles which were wholly or partly enclosed by calcareous material. The balloon-like bodies that were not attached to stems were easily detached from the floor of the pool, when they rose to the surface and almost invariably burst. The slight but almost constant agitation of the shallow water thus tended to prevent the formation of thick-walled or solid oolites.

Late in the summer, after the pool was drained, it was found that the "oolites" also formed in running water. At that time the spring water was allowed to run across the floor of the pool to a lower outlet. "Oolites" formed about gas bubbles in shallow pools and eddies along the sides of the stream, where agitation was at a minimum. The constant movement caused most of the structures to break soon after formation, however.

The gas bubbles were undoubtedly formed because of cooling and slight evaporation of the water which reduced the solubility of the carbon dioxide gas in the water. The bursting of the shells when they reached the surface may have been due to the sudden agitation, to the slight change in pressure, or to rapid partial drying on exposure to the air. No explanation is offered as to the mechanism that caused the formation of pedestals or the fact that most of the shells were thinner on top than on the bottom.

The occurrence has some bearing on the origin of oolites. Calcareous oolites are reported to form about gas bubble nuclei off the Florida coast.[3] The thin spherical coatings of calcium carbonate at Pinkerton also form about gas bubbles. It seems possible that under certain conditions these coatings could persist long enough to develop thick walls and thus become true oolites. The occurrence shows conclusively that some spherical bodies form without mechanical agitation, a conclusion at variance with that reached by some of the geologists who have studied oolites. At Pinkerton the "oolites" form both in quiet and in slowly moving water.

EDWIN B. ECKEL

U. S. GEOLOGICAL SURVEY

THE RELATION OF MAXIMUM CRUSHING STRENGTH OF WOOD TO THE DEGREE OF SWELLING INDUCED BY VARIOUS CHEMICALS[1]

THE object of these experiments was to determine the effect of a number of chemicals upon the strength of wood and the relationship of the latter with the swelling caused by the chemicals. Sets of small blocks of Norway pine sapwood (*Pinus resinosa*) were oven dried, measured and placed in various organic liquids, mostly alcohols. Other sets of blocks were not oven dried, but the moisture content was raised above the fiber saturation point; the blocks were measured and then injected with various aqueous solutions. After the proper time the following results were obtained:

An inverse correlation of crushing strength with swelling was found for wood which was saturated by various organic liquids. The organic liquids did not weaken the wood to the same extent that water did for any given amount of swelling from the oven-dry condition. The intensity of swelling declined as the alcohol molecules became more nearly hydrocarbon in

[2] R. D. George, *Colo. Geol. Survey Bull.*, 11: 291–292, 1920.

[1] The experimental work was done at the Division of Forestry, University of Minnesota. The project was completed at the Division of Forestry, West Virginia University.

[3] T. W. Vaughan. Florida studies, Carnegie Inst. of Wash., Year Book 11, 157–158, 1913.

constitution. More than 120 days were required for the swelling of wood to reach equilibrium in n-butyl alcohol.

Increased swelling beyond water-swollen dimensions by concentrated aqueous solutions did not necessarily cause decreased crushing strength. The chloride salts increased strength and swelling, although not in proportion to concentration or swelling. Thiocyanate and iodide salts, on the other hand, caused decided swelling but decreased strength, as did also resorcinol, pyrogallol and urea solutions. Chloral hydrate increased the crushing strength by about 40 per cent., yet caused the greatest swelling. Some radial contraction occurred in several aqueous solutions.

The experiments indicated that decreasing crushing strength of wood by organic liquids was associated with increased swelling. The strength of wood in concentrated aqueous solutions apparently was not governed by this standard. In both cases, specific effects of the chemicals on the wood were important. A detailed report will appear in another journal.

H. D. ERICKSON

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE METHOD FOR FILING MINIATURE NEGATIVES AND MICROFILM RECORDS IN STRIPS

THE increasing use in scientific work of miniature cameras and of microfilm records makes the problem of film storage of considerable importance. I venture, therefore, to describe a simple and inexpensive method for filing films of the smaller sizes.

Film negatives of 35-millimeter size are in my experience more easily handled in the enlarger if they are cut into strips than if they are kept in the long rolls. In particular there is less likelihood of the negatives in the strips acquiring finger marks and scratches.

Records copied on microfilm may also be kept conveniently in strips. It is much simpler to remove the desired strip from its storage pocket than it is to unwind a long roll of film and then to find on it the particular frame needed for consultation. On microfilm copies of scientific papers or books kept in strips any particular page is easily found. Some types of readers for microfilm handle the strips equally as well as the rolls, but it is possible that not all types of readers will handle the strips.

For filing strips of miniature film, stationers' envelopes, size No. 10, are very satisfactory. These envelopes measure $4\frac{1}{8}$ by $9\frac{1}{2}$ in size and are therefore long enough to take film strips made up of 6 double-frame negatives of 35-millimeter size. Each envelope is divided inside into a number of compartments by paper partitions. A sheet of paper $3\frac{7}{8}$ by $9\frac{3}{8}$ inches is just right to make a single partition. By the use of these dividing sheets all the film strips cut from one roll of 35-millimeter film may be stored in a single envelope. The usual roll of 36 exposures will require 5 partitions.

Papers or books copied on microfilm are usually arranged so that 2 pages go on a double-frame negative. A film strip of 6 double frames will therefore contain 12 printed pages. A book of 96 printed pages will, accordingly, go on 8 of these strips, which will not unduly crowd a single envelope. Most scientific articles are much shorter than this. Microfilm copies of books over 100 pages long will require 2 or more envelopes.

In the envelopes provided with paper partitions each film strip is kept in a separate paper compartment with no danger of rubbing against any other strip. When a film strip is to be removed from the envelope it is picked up by its uppermost edge. The unused margin of the film is of course wide, for it contains the perforations. If the strip is handled carefully no finger prints need ever be made on a negative.

The envelopes described can be obtained at a small cost from any stationer. If a standard size of envelope and standard grade of paper are chosen there should be no difficulty in future purchases in duplicating either the size of the envelope or the quality of paper. The paper for the envelopes and for the inside partitions should be of good quality linen. A poor quality of paper is likely to deteriorate rapidly and it may contain injurious chemicals. In damp climates the gum on the flap may inadvertently seal the envelope. To avoid this the gum can if desired be removed with a damp cloth.

The best time to cut the film into strips is as soon after development as it is dry. If the film has been kept rolled for some time it will have strong tendency to curl. However, if the film strips are placed in an envelope and then the envelope placed under a book or other weight for a few days the tendency of the film to curl will gradually be lost.

In cutting the roll of film into strips one should if possible divide it into lengths of 5 or 6 exposures each. Strips containing 4 exposures are also satisfactory, but I find that strips containing only 3 exposures are less easily handled in the enlarger or microfilm reader than are the longer strips. The inclusive frame numbers or page numbers for each strip should be marked in pencil on the upper edge of the paper partition behind the strip.

On the front of each envelope may be written data

referring to the whole roll of film which it contains. These data may include catalogue number or other designating mark of the roll, date and place of taking, photographer, kind of film, type of developer and ony other pertinent information.

Sheets of paper giving catalogue data, printing time for each negative or any other notes may be placed in the same envelope with the film. These data sheets are best made slightly smaller than the envelopes so that they may easily be inserted or removed. A convenient size is 3⅝ by 8½ inches.

Film strips of any of the smaller sizes can be kept in the envelope described above. In a No. 10 envelope any width of film up to 3¼ inches can be accommodated. Envelopes containing films of different widths may of course be filed together.

The envelopes containing the film strips may be grouped into packages by placing moderately heavy rubber bands around them. Sheets of cardboard the same size as the envelopes and placed on each side of the package will protect the edges of the envelopes from undue wear. The pressure of the rubber bands will keep the film strips contained in the envelopes flat.

The packages of envelopes with their enclosed film strips may be filed in any manner desired, either in boxes or drawers. They fit nicely lengthwise in the drawers of filing cabinets designed for 4 by 6 cards.

The ease with which the film strips are inserted into and removed from the envelopes, the excellent protection given the film, the cheapness of the envelopes and the possibility of keeping as much data as may be needed with the negatives or microfilm records are the advantages of this simple method of filing films.

LEE R. DICE

UNIVERSITY OF MICHIGAN

CONTROL OF MOLD IN FOOD FOR DROSOPHILAE

IN many genetics laboratories where Drosophilae are used for breeding purposes food is still made with bananas as one of the principal ingredients. Banana food molds easily, and when it is kept for more than a day or two the mold usually gets started before the flies have time to produce larvae. The result is that often the flies do not breed well. In this laboratory molds of various species are exceptionally abundant, due largely to climatic conditions. The offenders are usually species of Rhizopus, Mucor and Aspergillus. Conditions have been so unfavorable that a special study was made for controlling molds in general. Contamination seemed to be from various sources, so that more than one method of control was necessary. Food is now made as follows with very pleasing results:

In a pyrex beaker 750 cc of water and 75 cc of white Karo syrup are mixed. To this is added 20 grams of shredded agar. The mixture is boiled until the agar is liquefied. In a separate container two medium-sized bananas are crushed and 25 cc to 30 cc of 95 per cent. alcohol is added. The bananas and alcohol are well stirred and allowed to stand about twenty minutes and are then added to the water-syrup-agar mixture after this mixture has quit boiling and has cooled to about 90 degrees Centigrade. The food amounts to about one liter in volume and is ready for bottling immediately. It is best to autoclave the bottles and cotton plugs, but this is not absolutely necessary. Since alcohol has been added already, it is not necessary to spray the food with yeast, as is done in some laboratories; and since no yeast is present carbon dioxide is not formed. The food adheres well to the bottom of the bottle and the flies do not stick to it easily. It has been kept in this laboraory almost two weeks without being covered with mold; however, when the bottles are not autoclaved contamination may appear within four or five days.

J. C. CROSS

THE TEXAS COLLEGE OF ARTS AND INDUSTRIES,
KINGSVILLE, TEXAS

BOOKS RECEIVED

BUROS, OSCAR K. *Research and Statistical Methodology; Books and Reviews, 1933–1938.* Pp. vi + 100. Rutgers University Press. $1.25.

Comité National Français et Comité National Marocain de Géodésie et Géophysique; Années 1933–34–35–36. Pp. 408. Comité Français, Paris.

EVANS, JAMES H. *Constructive Metal Work.* Pp. viii + 95. Illustrated. Arnold, London. $3.00.

FRAZER, R. A., W. J. DUNCAN and A. R. COLLAR. *Elementary Matrices and Some Applications to Dynamics and Differential Equations.* Pp. xvi + 416. Illustrated. Cambridge University Press, Macmillan. $8.50.

Inventory; An Appraisal of Results of the Works Progress Administration. Pp. 100. Illustrated. The Administration, Washington.

KRUMBEIN, W. C. and F. J. PETTIJOHN. *Manual of Sedimentary Petrography.* Pp. xiv + 549. 265 figures. Appleton-Century. $6.50.

LOWER, A. R. M., W. A. CAREOTHERS and S. A. SAUNDERS. *The North American Assault on the Canadian Forest; A History of the Lumber Trade between Canada and the United States.* Pp. xxvii + 377. Yale University Press. $3.75.

NAGEL, ERNEST. *Principles of the Theory of Probability; International Encyclopedia of Unified Science, Vol. 1, No. 6.* Pp. vii + 80. University of Chicago Press. $1.00.

NEEDHAM, PAUL R. *Trout Streams; Conditions that Determine their Productivity and Suggestions for Stream and Lake Management.* Pp. x + 233. 74 figures. Comstock. $3.00.

RAISZ, ERWIN. *General Cartography.* Pp. x + 370. 200 figures. McGraw-Hill. $4.00.

STANDLEY, PAUL C. *Flora of Costa Rica;* Botanical Series Vol. XVIII, Part IV, November, 1938, Publication 429. Pp. 1137–1571. Field Museum of Natural History. $2.50.

WILLIAMS, JOSEPH J. *The Maroons of Jamaica;* Vol. III, No. 4, of Anthropological Series, Boston College Graduate School. Pp. 379–480. Boston College Press. $1.00.